

The biology of the White-winged Duck

Cairina scutulata

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Information on the field biology of the little-studied and endangered White-winged Duck *Cairina scutulata* of South-East Asia is presented and reviewed. This is a shy, retiring species occurring at low densities at small wetlands amidst forest and usually seen around dawn or dusk as single individuals or in pairs. Breeding is concentrated in the wet season when food supply is likely to peak. The birds nest in tree holes and have a monogamous mating system, with the male attending the female throughout incubation. There is evidence of extended biparental care of young and long term pair-bonding. The birds have distinct and sexually dimorphic flight and non-flight calls. They have an omnivorous diet. The Indonesian population has long been recognised as morphologically distinct and is probably a separate race. Further research into the ecology of the birds is urgently required.

INTRODUCTION

The White-winged Duck *Cairina scutulata* is an unusual species of waterfowl which is dependent on small wetlands amidst level areas of tropical moist forest in South-East Asia. It is one of the largest duck species, with males slightly larger than females (Madge and Burn 1988). The birds feed in shallow, stagnant or slow-flowing streams, ponds, swamps or ricefields and roost and nest in nearby forest trees. Increasing concern for the status of this species recently led to a major review of all historic and current data on the species and preparation of a conservation plan (Green 1991, 1992). The species was formerly widely recorded from north-east India, Bangladesh, Myanmar (Burma), Thailand, Laos, Viet Nam, Cambodia, Peninsular Malaysia and Indonesia (Java and Sumatra). It was found to be "common" by eminent British ornithologists in areas of India, Myanmar and Thailand in the early part of this century. Since then, the species has undergone a major decline to perhaps less than 5% of its original population size. This decline has accelerated in recent decades due to more extensive loss of lowland tropical forests and increased hunting pressure. Approximately 40 small, surviving populations have been identified, mainly in highly fragmented areas of forest (Green 1992).

This paper contains the first comprehensive review of the biology of the White-winged Duck *Cairina scutulata* in the field, based on the findings of Green (1992). This results from a review of over 100 references and extensive communication with people who have observed the species. The most detailed field studies of *C. scutulata* to date, those of Husain and Haque (1981) and Chambers (1990) have not previously been published in readily

accessible media, and this paper reviews their major findings. Husain and Haque (1981) worked in the Chittagong Hill Tracts, Bangladesh, from 1976 to 1978. Their observations were concentrated in the wet season, when birds were easier to observe. Chambers (1990) records the results of a Southampton University expedition to Way Kambas National Park, Sumatra from August 1988 to July 1989, when birds were observed on 104 of the 300 days spent in the field. Extensive information on the biology of the species in captivity published by Mackenzie and Kear (1976) and Green *et al.* (1992) is not repeated here. A companion paper (Green in prep.) contains a comprehensive review of the status, habitat use and conservation needs of *C. scutulata*.

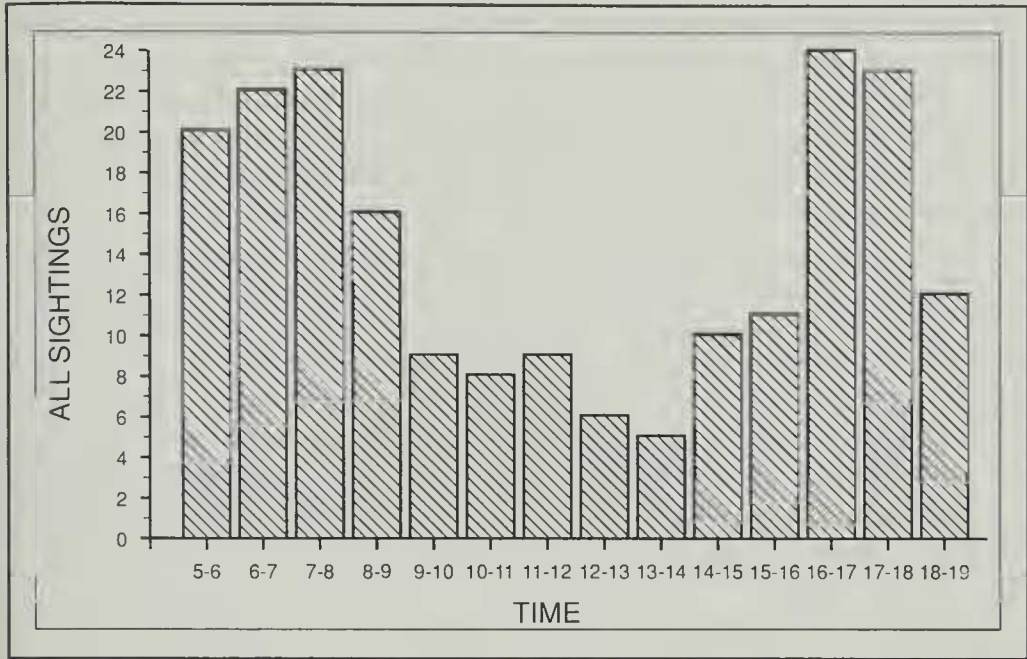
DIEL ACTIVITY PATTERNS

C. scutulata has peaks of locomotory and feeding activity at dawn and dusk, and birds are most often seen in flight at these times. Many authors describe birds as being seen regularly at dawn or dusk. Hutchinson (1946) refers to a drake seen flying down the Dhansiri river, north-east India, every night at dusk (around 18h30) in July 1945. Evans (1901) describes how a pair of *C. scutulata* visited a jheel near Bhamo, Myanmar, every evening but was never present during the day. In the Jade Mines of Myitkyina district, Myanmar, Stanford and Ticehurst (1939) saw *C. scutulata* 'flying regularly at dusk to feed on wet stubble where streams ran out into the fields'. Smith (1942) stated that *C. scutulata* was regularly observed flying along the Shweli river, Myanmar, at dawn and dusk singly or in pairs.

Chambers (1990) obtained numerous data on activity in daylight hours between 05h00 and 19h00 in Way Kambas National Park. These reveal a strong dawn and dusk peak to activity with most sightings being made in early morning and evening (Fig. 1). These crepuscular peaks occurred throughout the year, but there was considerable variation in the activity patterns observed. Sometimes birds showed a nocturnal feeding pattern: at forest ponds, birds were usually observed to arrive in the evening to feed, stay the whole night and leave the following morning. However, on two occasions a duck remained on a pond the whole day and fed in direct sunlight in the middle of the day. Birds feeding at rice paddies flew in late in the afternoon and returned to forest either at dusk or the following morning, presumably after feeding through the night. Locals also reported hearing birds flying over fields at night. In December and January, birds were regularly seen flying into, flying out of or feeding in Rawa Gajah swamp at all times of day, whilst having crepuscular peaks in sightings.

Many authors have suggested that birds are relatively inactive in the middle of the day but remain close to feeding sites, while at night they roost farther away in the forest. In India and Bangladesh, Mitra (1957) and Gee (1958) observed that in the middle of the day the ducks remain in the shade of a tree

Fig. 1. Diurnal activity of *Cairina scutulata* in Way Kambas NP from Chambers (1990). Figures represent the number of days on which at least one duck was observed in each time period. No observations were made at night.



on the water or on a branch. Mackenzie and Kear (1976) found that they sometimes roost 'on driftwood or on low branches over the water' at this time. In southern Sumatra, Hoogerwerf (1950) reported that *C. scutulata* sleeps at night on broad branches of high trees, and that it sometimes roosts in the same place for months in succession. In Thung Yai Wildlife Sanctuary, Thailand, birds are thought to roost in trees at night and forage during the day in meandering streams in the forest. On several occasions, birds have been seen flying into Lake Lakutu in the late afternoon, roosting overnight in the crown of high trees and flying out before first light (P.D. Round *in litt.* 1990; N. Bhumpakphan *pers. comm.* 1992).

Husain and Haque (1981) found that breeding birds outside the breeding season and non-breeding birds throughout the year flew singly or in pairs to feeding grounds at a ditch or stream around dawn and spent the whole day there. At dusk, they flew away to roost in trees in the forest, either at the edge of the stream or creek where they fed, or deeper in the forest. While at the feeding site, feeding was concentrated in the morning and evening. The middle of the day was spent sitting on a log in water or on the bank, or floating under the shade of a Jarul tree *Lagerstroemia speciosa*. During 55 hours of observations of an unknown number of birds over 13 days, feeding was more intense in the morning than in the evening. In the morning, 57% of the time was spent feeding and 43% resting and preening. In the evening, only 35% of the time was spent feeding. Preening bouts were conducted on the bank,

a low tree overhanging the water or on a log.

Some authors report an even stronger crepuscular pattern in which birds only visit wetlands at dawn and dusk times. Husain and Haque (1981) found that breeding pairs in Bangladesh only left the nest site to feed around dawn and dusk. Robinson and Kloss (1910-1911) found that in Trang province, Thailand, *C. scutulata* came 'down to the partially flooded rice fields to feed in the early morning and late afternoon. In the evening, after feeding, it went off to roost in the patches of jungle growing on small and steep hills rising from the general level of the rice-fields.'

Other authors have reported the birds feeding throughout the night, suggesting a nocturnal rhythm. Ali and Ripley (1968) state that the birds fly at dusk to feed in more open waters and marshes during the night, returning at dawn to secluded forest pools. Mukherjee (1961) found that wild birds made nocturnal visits to standing crops around Assamese villages. Scott (1989) reports that in Lam Dom Yai, Thailand, 'a few individuals are believed to flight out of the forests at night to feed in rice paddies'. Delacour and Jabouille (1931) describe *C. scutulata* in Laos and Vietnam as spending the day roosting on large trees in the forest, and flying to marshy clearings in the forest at night to feed.

The diel rhythm of *C. scutulata* is rather variable but whether birds feed through the day, through the night or just at crepuscular times, their movements between feeding, roosting or nesting sites are concentrated at dawn and dusk. Such peaks in activity just after dawn and just before dusk are rather typical of tropical forest birds, and have been recorded e.g. in the Salmon-crested Cockatoo *Cacatua moluccensis* (J. Bowler *pers. comm.*). Various observations suggest that *C. scutulata* adjusts its diel rhythm opportunistically according to the timing of food availability or of habitat disturbance. Thus a nocturnal feeding pattern may be a response to hunting pressure and general human disturbance, particularly in rice fields. Activity is also likely to vary according to food availability and the breeding cycle: birds are likely to spend longer at feeding sites if foraging intake rates are low or if they are putting on energy reserves prior to nesting. Diel rhythms are also adjusted in response to breeding activity and, during incubation, pairs only feed at dawn and dusk. Tim Ekspedisi (1991) found that the ducks in Way Kambas National Park only feed at night when sufficient moonlight is available, and rest on moonless nights. On 22 August 1990 a duck was seen roosting by a pond at night but became active when a torch was switched on and began feeding in the torch beam.

SEASONAL ACTIVITY PATTERNS

Most records of *C. scutulata* from Continental Asia come from north-east India, Myanmar and Thailand where the climate is monsoonal with a rainy season from around May to October and a pronounced dry season from around November to April. In the literature, sightings of *C. scutulata* in each of these countries are most frequent in the dry season (Fig. 2). A likely explanation is that ornithologists are less active in the wet season because the rains make travel unpleasant and difficult. However, this pattern might also indicate a change in the behaviour of the birds during the wet season that makes them less apparent to man, e.g. a movement from forest edges to deep in the forest associated with breeding. Evidence against this hypothesis comes from Husain and Haque (1981) who found that birds in Bangladesh were easier to observe in the wet season because they were using more open wetlands. During the dry season from December to March, most streams dried up, and the ducks concentrated in the few ditches deep inside the forest that still contained water.

The climate encountered by *C. scutulata* in Indonesia is rather variable. The north-west coast of Sumatra has more or less opposite rainfall peaks to the south-east coast (D.A. Holmes *in litt.* 1991). *C. scutulata* occurs in both these and other areas (Green 1992). In south-east Sumatra, Lambert (1988) and Chambers (1990) found that birds were easier to observe in the wet season of November to March when they were using more open, seasonal swamps. During the early dry season, birds were seen most often on small forest ponds, whilst towards the end of the dry season they were hardly seen at all and local reports suggest they may move to permanent swamps less accessible to man.

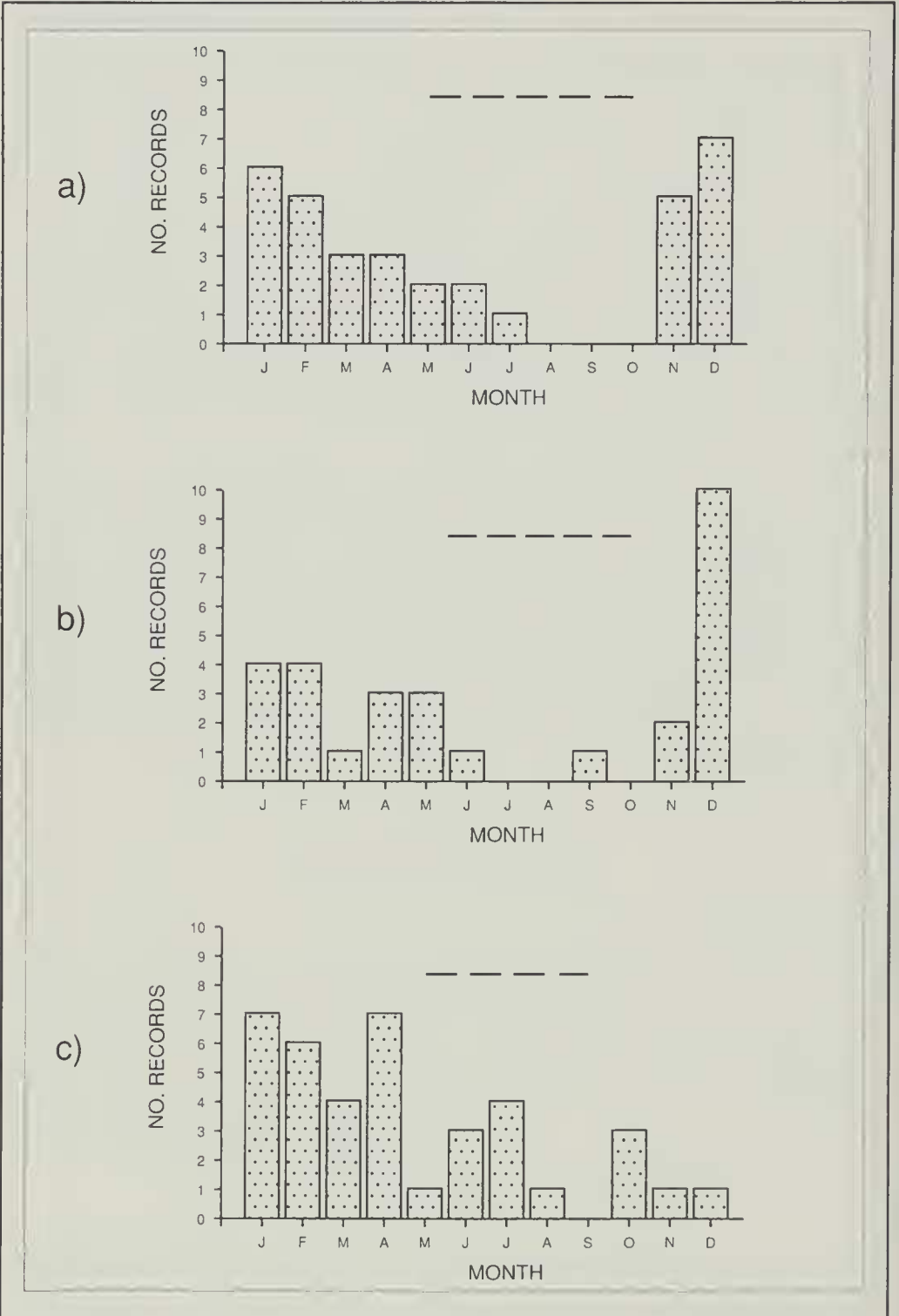
BREEDING BIOLOGY

Breeding season

In Bangladesh, Husain and Haque (1981) found the breeding season lasted from March to the end of July, with a wet season from April to November. They found three nests in use; two in April and one in June. In mid July, two groups of fledged young were seen (Husain 1977). In captivity, eggs have an incubation period of about 33 days, and chicks take about 14 weeks to fledge (Mackenzie and Kear 1976). This suggests that laying begins in March at the very end of the dry season, and continues until June, whilst hatching occurs from April onwards to coincide with the early wet season.

Baker (1908, 1929) found a nest with an egg on 30 June in the hills of North Cachar, India, which was assumed to be of *C. scutulata*. The size of ducklings taken from the wild in Assam for captive breeding in 1969-1975 suggests that laying occurs up to the end of June or early July (Mackenzie 1975). In

Fig. 2. The timing of dated sightings of *Cairina scutulata* in the literature for a) Thailand, b) Myanmar and c) India. If several birds were seen together, this counts as one sighting. Dashed line indicates the timing of the wet season.



captivity in Assam, laying begins between 18 March and 4 June (Mackenzie and Kear 1976). A pair of adults with young was seen in Phu Khieo Wildlife Sanctuary, Thailand, on 20 July 1990 (Round 1990). A female with young was seen in June 1959 at Pidaung sanctuary, Myanmar (Milton and Estes 1963). Again, these data suggest that breeding in India, Thailand and Myanmar is timed so that hatching occurs in the early phase of the wet season, which begins in May. Food availability for this duck species that specialises in feeding in shallow water is likely to peak in the wet season when floods increase the area of available habitat.

Information on breeding in Indonesia comes from southern Sumatra and Java. Hoogerwerf (1949, 1950) suggested that *C. scutulata* breeds in the wet season, laying from December to February. He referred to two clutches collected in central Java in February, and others found in southern Sumatra in December, January and February. Hoogerwerf received local reports from Lampung that eggs are laid at the height of the wet season when rivers are most flooded. There are local, unconfirmed reports of adults with young in southern Sumatra from Sungai Tulang Bawang in January 1977 (Holmes 1977) and Way Kambas National Park one October (Ounsted 1985), October 1985 and September–November 1985 (Lambert 1988). There are also confirmed reports from Way Kambas on 29 March 1988 (Robson 1988), 18 July 1990 and 20 July 1990 (Tim Ekspedisi 1991). No information is available on the age or size of the ducklings seen. These data suggest a very prolonged breeding season in southern Sumatra, with young seen from October to July. Nesting must extend at least from September to March. As the dry season in southern Sumatra extends from about May to October, these data suggest that breeding is concentrated in the wet season, but can begin in the last months of the dry season. The timing of the breeding seasons of tropical birds is typically variable (e.g. Medway and Wells 1976), and perhaps the October sightings were made in years when the wet season started particularly early. The timing of breeding by *C. scutulata* is likely to differ in other areas of Sumatra which have a different climate.

Clutch and brood sizes

Husain and Haque (1981) found three, four and seven eggs in nests in Bangladesh. Two clutches found in southern Sumatra in December had six and nine eggs, although this may not be the total clutch size as incubation had not yet begun. Locals in Lampung reported that clutches often contained more than 10 eggs (Hoogerwerf 1949, 1950). In captivity, clutch sizes vary from six to 13 with a mode of 10 (Mackenzie and Kear 1976). From eight broods of ducklings observed by Husain and Haque (1981), the mean brood size prior to fledging was 3.9 ducklings. Similarly, nine broods of ducklings recorded in Indonesia, Thailand and Myanmar (seven in Indonesia) ranged in size from two to seven with a mean of 4.0 and Standard Deviation of 1.8.

Nest sites

Husain and Haque (1981) observed three nesting pairs. In addition, 'several other trees used by the duck for nesting' were located. The nests were in tree holes 'generally 2-2.5 feet deep and the entrance is 1 sq. feet to 3 sq. feet about 1 foot wide' (sic). The nests were lined with straw, leaves, grasses and roots of Water Hyacinth *Eichhornia crassipes*. In all but one case, the nest tree was a Civit tree *Swintonia floribunda* (fam. Anacardiaceae) that was the tallest tree in the middle of a forest area, with a hole situated well above the tree canopy allowing easy access for the ducks. One Civit tree nest hole was 12 m high in a 37 m Civit tree, above a canopy 6 m high. A second hole was 23 m high in a hollow branch of a 38 m Civit tree in primary forest. A third nest was found in a Barta tree *Artocarpus lakoocha* by the side of a stream in the middle of a secondary reserve forest of Teak trees *Tectona grandis* of about 12 m high. This nest hole was well below the canopy, 4 m above the ground, and the ducks used the course of the stream for access. Khan (1983) also stated that other softwood trees such as Chapalish *Artocarpus chaplasha* and Uriam *Mangifera longipes* are used for nesting. The nest found in Assam by Baker (1908, 1929) was on the bank of a stream in dense forest where he had seen a pair of adults. The nest was in a deep hollow caused by decay, 6 m above the ground in the fork of a thick tree where three boughs branched out from the main trunk. The nest was a mass of grass and other rubbish with a lining of feathers and down.

Hoogerwerf (1950) described a nest in southern Sumatra 3 m above the ground at the top of a Rengas tree stump, surrounded by new, leafy shoots from the stump. A second nest was found in a bowl-shaped cavity between three large branches of a 'Boengoer' tree in flower. Both nests consisted of dried leaves, grasses and a few down feathers. Locals from Lampung reported that nests are generally 6-8 m above the ground in cavities between large forks or in large tree holes. Holmes (1977) was shown four reputed nest holes in Rengas trees. One was 4 m up in a deep hollow in a tree fork, in a dense grove of forest. Another was a hole 8 m up in the straight trunk of a tree, in the open in a deep swamp. A third was 5 m up in a large hole in the decaying trunk of an old tree standing in tall grass in an open swamp.

Courtship behaviour

Chambers (1990) observed a possible courtship display on at least two occasions in December. A pair of ducks swam in an irregular zig-zag manner with one behind the other. Both birds threw their heads back to the shoulder and then forwards in a high arc and down to skim the water. The leader, thought to be the male, initiated the display. This possible courtship display was observed in Rawa Gajah, a swamp used by *C. scutulata* only for an intense period of activity from November to January, when groups of three to six

birds were regularly present. This timing and behaviour suggest this may have been a congregation site for courtship and pair formation. Copulation was observed twice by Husain and Haque (1981) on shallow water. On 18 April 1977 at 11h30, copulation occurred for 45 seconds, with little display before or after. On 14 March 1978 a pair arrived at a ditch at 16h30 and began feeding. At 17h20, the male stopped feeding and approached the female while head bobbing 'up and down a couple of times'. They copulated for 60 seconds, then the male gave a loud 'kick' call and both birds began preening. They then returned to feeding and flew away at 18h18.

Incubation Behaviour and Parental Care

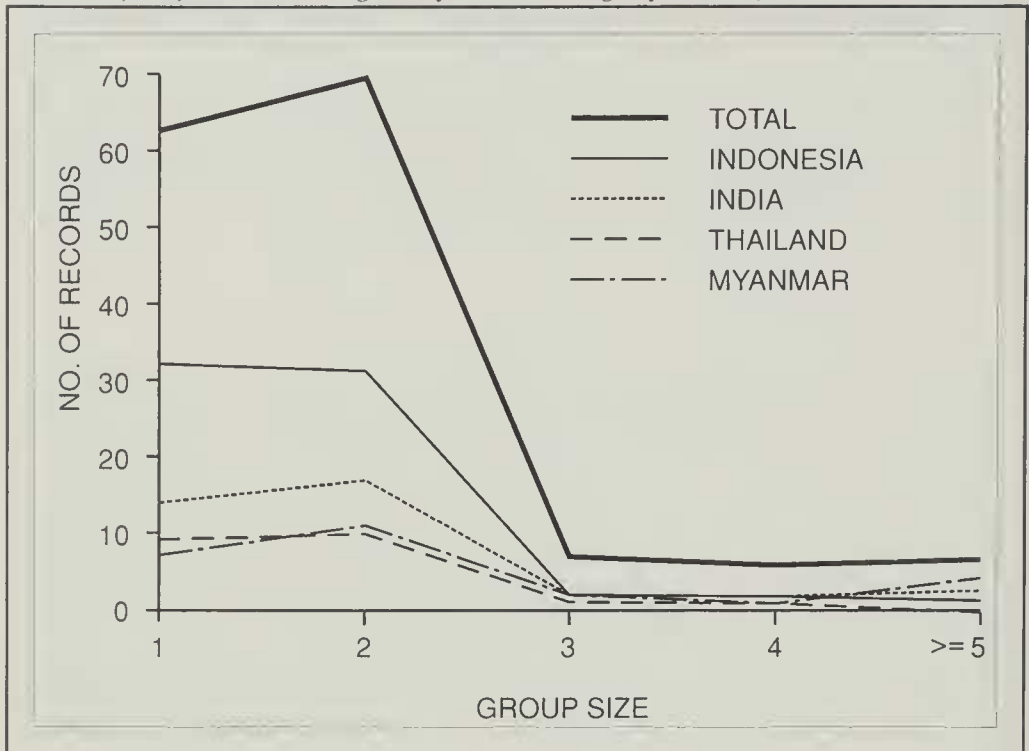
Continuous observations of three breeding pairs for 15 days by Husain and Haque (1981) revealed that the female did all the incubation, while the male remained in a tree 180 - 270 m away. The pairs only left the nest site to feed around dawn and dusk. In the morning they left between 04h30 and 05h30, and returned between 07h30 and 08h30. In the afternoon they left between 15h30 and 16h15 and returned around 18h18. The male attended the female closely, initiating the feeding trips by flying to the nest hole. He also escorted the female to the hole on their return, either sitting by the hole or flying around the nesting tree until the female settled down. These behaviours suggest males show mate guarding to ensure paternity of the eggs or to allow the female to increase her foraging rate and fecundity (Owen and Black 1990).

Husain and Haque (1981) found that as soon as the chicks left the nest they moved onto water in ditches, creeks and streams. Parental behaviour after the chicks leave the nest is unclear, as there are six records in the literature of one adult being seen with a brood and four records of two adults with a brood. This suggests that both adults show at least partial brood attendance.

GROUP SIZE AND MATING SYSTEM

All the observations of breeding activity by Husain and Haque (1981) indicated a monogamous mating system, with three pairs being closely studied. Robinson (1915), Gee (1958), Mukherjee (1961), Mackenzie and Kear (1976) and other authors state that birds are usually seen singly or in pairs, with occasional larger groups being seen. This is confirmed by quantifying the sightings of adult *C. scutulata* from over a hundred literature and correspondence sources from India, Myanmar, Thailand and Indonesia. These indicate that single birds and pairs are the most common group size, whilst groups of three or more are rarely seen (Fig. 3). This suggests a monogamous mating system and, since most continental sightings occur in the dry season of November to April, is consistent with a possible long term

Fig. 3. Known group sizes of *Cairina scutulata* sightings in the literature for India, Myanmar, Thailand and Indonesia, excluding unreliable records, those of adults with ducklings and those in Sumatra by Chambers (1990). Where authors give only the maximum group size seen, these data are excluded.



or even continuous pair bond through most of the dry season followed by breeding around the beginning of the wet season.

Husain and Haque (1981) found that one to six birds roosted or fed together in the same area outside the breeding season and up to five adults were seen in the same tree (Husain 1977). Eleven is the largest group reliably recorded in the literature (Parsons 1940). The character of larger groups is unknown, but some are thought to be families that have not split up. In Bangladesh M.A.R. Khan (*in litt.* 1991) saw both parents together with fledglings. Mackenzie and Kear (1976) suggest that large groups seen in India are usually family parties seen from about June to October after the breeding season. However, groups of up to nine were also seen later in the dry season feeding together in wetlands but arriving and leaving in pairs. These may be unrelated groups involved in courtship activity or formed by necessity because of the shortage of feeding habitat at that time of year. In 1992 there was a widespread drought in Indonesia. As a result, birds in Way Kambaş National Park were highly concentrated on the few wetlands that remained, and up to 16 adults were seen together on one small pond (Rudyanto *in litt.* 1992).

Chambers (1990) found that about 95% of their sightings were of one or two *C. scutulata* (Table 1). Over 60% of all sightings were of single ducks and

Table 1. Group sizes of *Cairina scutulata* recorded by Chambers (1990) in Way Kambas National Park.

	SINGLES	PAIRS	THREES	GROUPS OF > 3 DUCKS
AUG./SEPT.	11	2	-	-
OCTOBER	3	1	1	-
NOVEMBER	10	5	-	-
DECEMBER	10	15	3	-
JAN./FEB.	10	5	1	1
MARCH	9	3	-	-
APRIL	7	6	-	-
MAY	13	3	1	-
JUNE/JULY	17	7	1	-
TOTALS	90	47	7	1

Continuous observations from Rawa Gajah swamp are excluded because birds were continuously arriving and leaving, changing the group size.

67% of all ducks found feeding on ponds or swamps were single. Only in Rawa Gajah swamp in December to February were groups of three or more birds regularly seen together. Forest ponds used mainly for feeding during the dry season were never found to contain more than two ducks. There is evidence of a seasonal change in group size, as December is the one month when the number of pairs exceeds the number of single birds (Table 1). This is possibly the time of pair formation, either for all breeders or for young birds breeding for the first time. However, such field data may not reflect the true distribution of group sizes as only a fraction of the population is sampled. For example, breeding birds may spend most of their time at nest sites and be seen less often than non-breeders.

FEEDING

C. scutulata is omnivorous, and diet is certain to vary with feeding site and seasonal availability. The main feeding technique observed by Husain and Haque (1981) was dabbling in very shallow water, taking mainly aquatic snails *Vibira* but also pondweed *Hydrilla*, small fish, aquatic spiders and insects. Occasionally the birds dived under water to catch fish. In Assam, Oates (1899) found that dissected stomachs revealed 'principally vegetable matter with a few small pieces of pebble'. Stevens (1914) found shells

(presumably molluscs) in the gullet of one bird. A drake shot by Hutchinson (1946) in July 1945 had its crop filled with 'small black pyramidal seeds of an aquatic plant which abounds in the jheels in Assam'. Robinson (1909) examined the gut of two birds shot in December while feeding in rice fields in Trang province, Thailand, and found their crops and gullets full of large freshwater snails *Ampullaria*, accompanied by 'one or two' freshwater mussels. Delacour and Jabouille (1931) reported that *C. scutulata* feeds on seeds, insects, worms, little fishes, frogs etc. This information may have been based on the observations in captivity of previous authors such as Baker.

In Sumatra, Hoogerwerf (1950) found stomachs of several dozen birds to contain only vegetable matter: algae, grasses, small tubers of rushes and 'teki tubers' (a type of grass). Chambers (1990) found the birds to eat animal matter, including grasshoppers, tadpoles, dragonflies and small fish. In deeper water, ducks swam around and changed direction rapidly, stabbing the bill into the water as if taking food from just below the surface. The head was rarely immersed. In water of a few inches depth, ducks waded around with beak immersed, occasionally twisting and thrusting the head forward as if chasing prey.

VOCALISATIONS

C. scutulata is often heard calling in flight or while stationary. Chambers (1990) found that birds gave honking calls when in flight or when flushed. 51% of single birds (N=70) and 91% of paired birds (N=34) called. There are likely to be seasonal differences in the frequency of vocalisations, but these are not known. There is considerable ambiguity in the literature about the nature of *C. scutulata* calls and of sexual dimorphism. Baker (1908) referred to the ringing, trumpet-like flight call of *C. scutulata*, and said that ducks in captivity made a very low quacking note with head held low and bill wide open, as well as an aggressive hissing. Hutchinson (1946) described the main call used by single birds in flight and that used by pairs when together as a "low whistle" and the call given when alarmed as a 'loud goose-like "honk"'. Parsons (1940) refers to 'their peculiar whistling call' while Stevens (1914) describes it as 'an unmistakable long drawn "honk"'. Engelbach (1952) described the call as resembling the trumpet call of geese. Hoogerwerf (1950) described the flight call as 'tatta-tatta-tatta' repeated every three to five seconds. When feeding and landing at roosting sites, they utter a weaker call of 'tietieta-tietieta-tietieta'.

Stanford and Ticehurst (1931) states that the flight calls of *C. scutulata* are sexually dimorphic with the male producing 'a low "cronk", "cronk" ' and the female 'a whistle'. Delacour and Jabouille (1931) liken the male call to a trumpet call, and describe that of the female as a quiet crowing. Holmes (1976) stated that birds called more or less continuously in flight, producing

a goose or crane-like honk, which was often heard simultaneously with a high whistle when two birds were flying together. Thus he suggested that the male and female produce separate, distinct calls.

Mackenzie and Kear (1976) described the flight call as a 'prolonged, vibrant, wailing honk sometimes breaking to a nasal whistle at the end' and were uncertain as to whether the male made the honk and the female the whistle. They also described a shorter honk produced on the water 'often sounding as though the bird were losing its voice or there were two calling simultaneously in different keys', and an aggressive hiss made while holding the head low. Loud calls made by pinioned birds in captivity vary considerably in their duration and number of syllables, and are often accompanied by a head-bobbing display. There is a clear sexual dimorphism in these calls, with female calls having a lower overall frequency and more harmonics than male calls. It is also clear that wild birds have a flight call that is not produced by pinioned birds (personal observation).

PREDATORS

There is very little information about natural causes of *C. scutulata* mortality. Gee (1958) reported two sightings of *C. scutulata* being attacked by unidentified hawks Accipitridae while flying. One was struck down into the reeds but managed to fly away. In Bangladesh, an adult was killed by an otter *Lutra* in 1978 (Husain and Haque 1981). However, this bird may first have been trapped in a fishing net.

POPULATION DENSITY

There are some data on the densities at which *C. scutulata* is found, measured as birds per unit land area. Since the species is dependent on both forest and wetlands, it may be more relevant to relate the numbers of birds to the area of wetlands available in the forest, or to the length of forest-wetland interface, but such data do not exist. Husain and Haque (1981) found that all the known feeding, roosting and breeding sites of *C. scutulata* in the Pablakhali area fell within an area of 15,200 ha. The maximum number of birds recorded by surveys in this area was 28. This gives a *C. scutulata* density of one adult per 540 ha, including both breeding and non-breeding birds. The maximum number of breeding pairs recorded in this area was five in 1977, giving a maximum density of one breeding pair per 3,040 ha. In 733 ha of mature forest in Duamara RF, Assam, in 1969-1970 there was a known population of eight adults (one adult per 92 ha) with an estimated peak of 14 birds (one bird per 52 ha including two family parties, Mackenzie and Kear 1976). Assuming that two breeding pairs of adults were present, this gives a

density of one breeding pair per 370 ha. Mackenzie and Kear suggest that in ideal habitat the maximum density of *C. scutulata* is likely to be no more than one adult per 50 ha. These data suggest that the density of birds was approximately ten times higher in Duamara RF than in Pablakhali Wildlife Sanctuary, probably because the Pablakhali population was living in more disturbed secondary habitat and was subjected to considerable hunting pressure (Husain and Haque 1981, Green 1992).

In Sumatra, Holmes (1977) estimated that in densely populated areas of Lampung, or in extensive coastal swamps, *C. scutulata* may have a density of no more than one adult per 250 ha, whilst unconfirmed local information suggested that in the less populated Menggala area of Lampung there may have been eight adults in an area of 500 ha (i.e. one per 63 ha), although some of the villagers' information may have been duplicated. Tim Ekspedisi (1991) estimated 20-30 birds for the Way Kanan/Kali Biru/Kali Batin area (c. 7,600 ha of habitat) of Way Kambas reserve in 1990, giving a density of approximately one bird per 300 ha, including non-breeders. Thus there is evidence that recent densities of the two largest known surviving populations of *C. scutulata* (Way Kambas National Park and Pablakhali Wildlife Sanctuary) are much lower than those formerly attained in areas less affected by habitat degradation or hunting.

MOULTING

Baker (1908) observed that captive *C. scutulata* in Assam moulted rapidly in September or early October, undergoing a flightless period of two weeks. Chambers (1990) observed an adult bird in moult on 2 May 1989, standing on a log in a forest pond, while preening and flapping its wings for at least 15 minutes. Whether the feathers being shed were wing or body feathers is not known. Even in captivity, it is not known whether *C. scutulata* moults its wing and body feathers together. This limited evidence suggests that a flightless moult occurs at the end of the breeding season as in most Anatidae (Owen and Black 1990).

LEUCISM

Indonesian *C. scutulata* have long been known on average to be much whiter than Continental Asian birds. Blyth (1867) wrote 'two mostly white [Javan] specimens in the British Museum look very like a domesticated race of this species'. Since then, many authors have suggested that the whiteness is a result of either domestication or inbreeding in the wild (e.g. Hume and Marshall 1880; Salvadori 1895; Mackenzie and Kear 1976), but there is no evidence for either theory. The whiter pigmentation is more likely to have

evolved through natural selection, and to suggest that the Indonesian population is whiter because it is more inbred has no more basis than to suggest that the white morphs of the Lesser Snow Goose *Anser caerulescens caerulescens* are simply inbred versions of blue morphs, which is not the case (Cooke *et al.* 1985).

Hoogerwerf (1950) and Chambers (1990) described the leucism on the body and found that males tend to be whiter than females. There is however much variation in the extent of white on the head, back, belly, tail-coverts, rump and wing-coverts in both sexes and some birds also have two or three white primaries. There is apparently a continuous variation in Indonesian birds from dark continental type birds to birds that are almost entirely white (Mackenzie 1990). What remains unclear is whether this variation exists because a) birds change with age, perhaps becoming more white as they get older or b) there is a genuine polymorphism, with different colour morphs in the same population. In other wildfowl, there is a development of more extensive white plumage in older individuals of Laysan Teal *Anas laysanensis*, whilst there is a sympatric mixture of dark and white morphs in the Snow Goose. The limited available evidence supports the ageing hypothesis because there appears to be a continuous variation of white extension in *C. scutulata* (as in *A. laysanensis*), and Baker (1908) found that Indian drakes in captivity became more white with age on the head and neck, especially around the eye.

The morphological difference between the Indonesian and continental *C. scutulata* is likely to stem from a considerable genetic difference, and the two populations should perhaps be regarded as separate subspecies: *C. scutulata leucoptera* for Indonesia (following Blyth 1849; Hume and Marshall 1880; Hoogerwerf 1950) and *C. scutulata scutulata* for the continent. Indeed, two races would have been notified in the last century were it not for the suggestion that the Indonesian birds were a domesticated race (Hume and Marshall 1880). There is no evidence that *C. scutulata* was ever present in continental Malaysia in the areas closest to Indonesia, the nearest record being over 120 km across the sea from the Sumatran coast. This suggests that the two populations have been isolated at least since the end of the Pleistocene (D. A. Holmes *in litt.* 1991), 10,000-12,000 years ago. Since there is little evidence that *C. scutulata* was ever well established in Malaysia (Green 1992), the two populations may have been isolated for considerably longer.

DISCUSSION

The White-winged Duck *Cairina scutulata* is an unusual waterfowl and differs considerably from more typical duck species that are migratory, form sizeable flocks on large, open wetlands, show marked sexual dimorphism and

have short term pair bonds with males showing no mate attendance or paternal care after incubation begins (Owen and Black 1990). Long-term pair bonds and paternal care tend to occur in species with little sexual dimorphism, so the evidence for these behaviours in *Cairina scutulata* is consistent with the fact that this species shows little sexual dimorphism.

The information on the biology of *C. scutulata* presented here is of considerable value in understanding the conservation needs of the species and in planning conservation programmes. For example, it is clear that field surveys to locate the species should be concentrated around dawn and dusk periods. Whilst most sightings have been made in dry seasons, individual workers have found it easier to see the birds in the wet season. Hence surveys are well worthwhile under both conditions. Observations in captivity (Green *et al.* 1992) suggest that playback of conspecific calls in the forest may be useful in locating birds at other times of the day and in locating pairs at the nest. It is clear that the dependency on tree holes for nesting makes the species particularly vulnerable to logging of old trees containing holes (Khan 1986), since the birds have no way of making their own holes. The number of tree holes available has been found to control population size in other hole-nesting wildfowl such as the Wood Duck *Aix sponsa*. The provision of nest boxes has dramatically increased the population size of *A. sponsa* (Bellrose 1978), and is a possible management measure for *C. scutulata*. There is also some evidence that some populations of *C. scutulata* could be limited by the small amount of feeding habitat available at the height of the dry season. Observations during the drought in Way Kambas National Park in 1991 suggest that such droughts have the potential to eliminate some populations of *C. scutulata*.

There remains an urgent need for further research into the biology of *C. scutulata* in order to improve our understanding of what measures can assure the conservation of the species (see Green 1992 for details). There is a particular need for long term studies that address such questions as: what limits population density and breeding success in each site? (nest site availability? dry season feeding? hunting? territoriality?); what is the home range or territory size of individuals, and how far can they disperse between forest areas?; what seasonal movements and seasonal changes in habitat use occur?; what sort of nest holes and nesting trees are preferred? There is also a need for genetic analyses to establish whether the Indonesian and Continental Asian populations of *C. scutulata* should be treated as separate races each worthy of their own conservation plans. The author would like to hear from anyone in a position to undertake any of these field studies.

Many people have contributed to this study, and full acknowledgments are given in Green (1992). I am particularly grateful to A. Chambers, K. Z. Husain, M. N. Haque, Rudyanto and Tim Ekspedisi for providing us with their information. J. Bowler, D. A. Holmes, M. A. R. Khan, N. Bhumpakphan, and P. D. Round also provided very helpful information. Mario Bertuca prepared the figures.

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